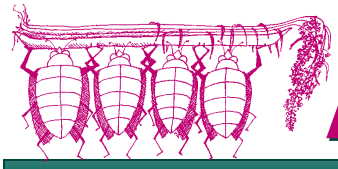
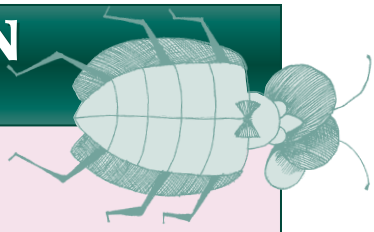


ACTIVITY 1 GRADES 8-12

ALIENS MOVING IN NEXT DOOR*



Objectives

➡ **Students will become familiar with the impact of exotic species (specifically purple loosestrife) on ecosystems by investigating a local schoolyard plant's biotic potential and environmental resistance.**

➡ **Students will create an imaginary exotic plant to compete for a local plant's niche and evaluate the possible results.**

➡ **Students will be able to define the terms biotic, abiotic, biotic potential, environmental resistance, native species, exotic species, and invasive species.**

Time Requirement

Three 45-minute class periods.

Wisconsin Model Environmental Education and Science Standards

***Environmental Education*: A.8.1, A.8.4, A.8.5, B.8.8, D.8.5, D.8.6, A.12.1, B.12.3, B.12.6, C.12.1. *Science*: A.8.6, B.8.4, C.8.1, C.8.2, C.8.5, C.8.10, C.8.11, F.8.1, F.8.2, F.8.6, F.8.7, F.8.8, F.8.9, G.8.5, H.8.2, A.12.4, A.12.3, C.12.1, C.12.5, F.12.5, F.12.7, F.12.8, G.12.2, G.12.5, H.12.4.**

DESCRIPTION

Students discover and apply information about a schoolyard plant's biotic potential and environmental resistance. Students chart the information and predict results of the introduction of an imaginary invasive species and apply this learning to the problem of purple loosestrife.

PROBLEM

What are the characteristics of a plant that allow it to become dominant within its environment?

MATERIALS

- ❑ Plant identification books.
- ❑ Clipboards.
- ❑ Plain paper.
- ❑ Background information on purple loosestrife (page 7).

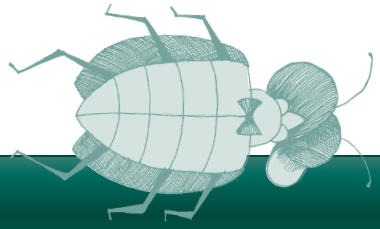
PROCEDURES

1. In the classroom, introduce the concept of dynamic balance between biotic potential and environmental resistance relative to population growth. Take a mini-field trip outside in the schoolyard. Ask students, in small groups, to identify plants growing in the schoolyard and choose one for further investigation.

2. Have students create a chart to list the biotic potential and environmental resistance for each chosen schoolyard plant using plant books, encyclopedias, the Internet, and field observation.

Quackgrass

BIOTIC POTENTIAL	ENVIRONMENTAL RESISTANCE
Reproduction: runners and seeds	Competitors: dandelions, crabgrass, etc.
Growth: rapid	Drought
Migration: man spreads it, runners grow rapidly, seed dispersal	Predators: herbivores; mowed by people
Coping: hardy, thrives in most soils	Disease: attacked by bacteria, fungi, viruses



Activity 1. ALIENS MOVING IN NEXT DOOR *(continued)*

3. Discuss limiting factors and ask students to predict each chosen plant's population growth in the schoolyard.
4. Ask the same small groups to create and name an imaginary exotic plant species. Have them chart biotic potential and environmental resistance and draw a picture of the exotic plant.
5. Describe how the imaginary species would get into each chosen plant's ecosystem, and based on its biotic potential and environmental resistance, discuss ways in which people could control the plant's spread.
6. Hand out a reading on purple loosestrife (see page 7, for example). Read and discuss its identifying characteristics and how it arrived and spread in North America. List the biotic potential and environmental resistance of purple loosestrife on a chart similar to the "quack grass" example.
7. Work with students to formulate several hypotheses about the impact of purple loosestrife on an ecosystem. Ask students to defend the hypotheses with information about biotic potential and environmental resistance. Compare the hypotheses to the scenarios developed by the class for schoolyard plants.

BACKGROUND INFORMATION

Each organism shares its ecosystem with other organisms (biotics) that affect its ability to survive. The physical, non-living environment (abiotics) also affects the survival of organisms. At all times, the interplay of biotic and abiotic factors in the environment limits the growth and reproduction of individual organisms. We refer to an organism's push to grow and fill the environment with its offspring as its biotic potential. Some of the factors that increase the organism's biotic potential include high growth and reproductive rates, a good ability to migrate and invade new habitats, strong defense mechanisms, hardiness, and an overall ability to cope with adverse conditions (adaptability). Factors that offer environmental resistance (i.e. limiting factors that decrease the likelihood of survival or reproduction) include insufficient water or nutrients, unsuitable habitat, adverse weather conditions, predators, disease, competition for growth requirements, etc.

Ecosystems become more diverse and more stable as they evolve. The organisms within each ecosystem achieve a dynamic balance – each is connected to and dependent upon the others. Each organism's biotic potential interacts with its environmental resistance to keep its respective population in balance. This balance is dynamic; it changes over time. If some of the interactions are lost, if the balance is upset, the web of connections may begin to unravel.

Activity 1. ALIENS MOVING IN NEXT DOOR

D. BLUMER

Purple loosestrife may have a greater biotic potential or less environmental resistance than the native plant species with which it competes.

As people have traveled from place to place, they have altered the environment and carried along, sometimes intentionally and other times accidentally, species of plants and animals not indigenous (native) to a region. These organisms are called introduced, non-native, or exotic species. Many introduced species never become established in the wild (naturalized) and their populations simply collapse within a generation or two. Successful invaders (invasive species), however, upset the balance of native ecosystems by permanently altering the environmental resistance for other species. When an invasive, exotic species invades an ecosystem, it may have a much greater biotic potential or significantly less environmental resistance than what the native species possess. When an exotic species has no predators to control it, it may outcompete indigenous organisms for space, nutrients, water, etc. The exotic species may be able to reproduce more successfully than local species. In this way, exotic species sometimes displace native species. To maintain the health of native ecosystems and be able to make informed personal and community choices, it is important to be aware of the impact exotic species (e.g., purple loosestrife, zebra mussel, sea lamprey, spotted knapweed, and round goby) can have on an ecosystem.

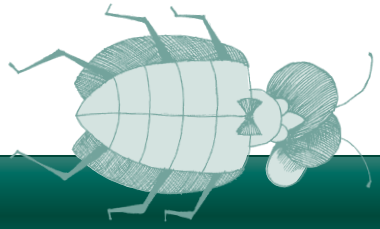
STUDENT ASSESSMENT

The following things can be considered when assessing student performance:

- Charts of biotic potential and environmental resistance.
- Drawing of imaginary exotic plant species.
- The biotic and abiotic limits to growth, biotic potential, and environmental resistance identified for the chosen schoolyard plant, imaginary exotic plant, and purple loosestrife.

EXTENSIONS

Students can draw a web showing interactions between their imaginary plant and its ecosystem. They can predict the population growth of their imaginary plant relative to other organisms in the web.



Activity 1. ALIENS MOVING IN NEXT DOOR *(continued)*

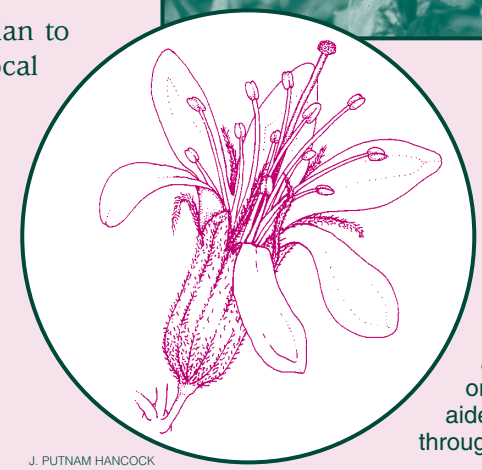
Students can create a biological control for their imaginary plant. Biological control is the use of one organism to control another. Have students list characteristics of the biological control species and describe how the imaginary plant will be controlled without harming the environment.

Ask students, as scientists, if they were to observe an increase in purple loosestrife over the next several years, what inferences would they make? Using the Internet, have them gather information on the spread of purple loosestrife over the last 100 years. Describe how their inferences compare to the historical record.

Interview people living in the area where there is a purple loosestrife infestation. Find out what they remember about the plant. How long has it been there? How fast have the numbers increased? Have they seen anything eating the plant?

Have students create an action plan to control purple loosestrife in a local wetland.

WISCONSIN WETLANDS ASSOCIATION



J. PUTNAM HANCOCK

Large purple flowerheads (inflorescence) have made purple loosestrife an attractive ornamental and aided its spread through commerce.

*Revised with permission from "Aliens Among Us," in *The Purple Loosestrife Project: Cooperator's Handbook*.

The Biology of Purple Loosestrife**

A herbaceous perennial wetland plant, purple loosestrife (*Lythrum salicaria*) is native to Eurasia. It was probably introduced to North America in the early 1800s via ship ballast and for use as a medicinal herb and ornamental plant. Infestation of native habitat has been increasing exponentially since 1880 (Thompson, et al. 1987). From 1940 to 1980, the rate of spread was approximately 1.5 latitude-longitude blocks per year. The plant is now (1995) established in each of the 48 contiguous states with the possible exception of Florida. The greatest concentrations are in the New England, mid-Atlantic Coast, and Great Lakes States.

About 35 species of *Lythrum* are known throughout the world. Twelve species are now recognized as occurring in the United States, three of which are exotics (including purple loosestrife). In addition, the horticulture industry has propagated numerous cultivars of purple loosestrife, some of which are capable of sexual and asexual reproduction and therefore contribute to the spread and diversity of the plant in the wild (Welling and Becker 1992).

Thompson, et al. (1987) described the optimum habitats for purple loosestrife in the eastern and central United States as "freshwater marshes, open stream margins, and alluvial floodplain." Light intensity appears to be critical to the growth of purple loosestrife as the plant is most vigorous at 100 percent light and exhibits reduced production at light levels below 50 percent (i.e. shaded sites). The plant is often associated with cattails (*Typha* sp.), reed canarygrass (*Phalaris arundinacea*), and other moist-soil plants.

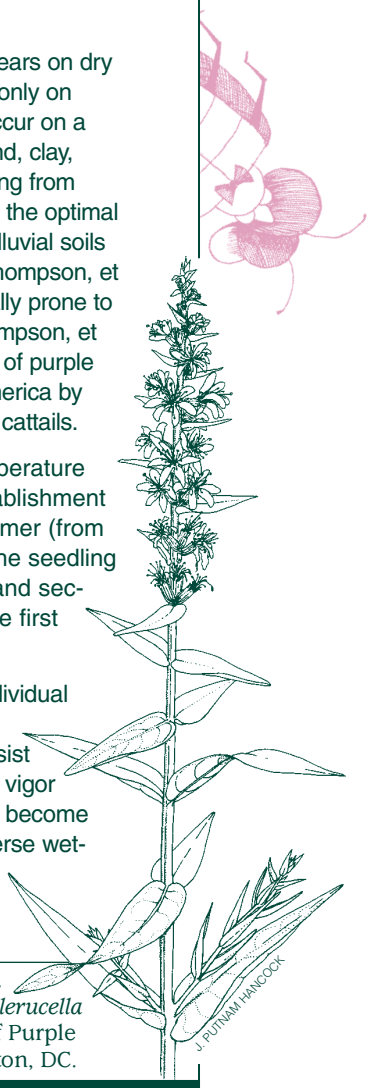
Purple loosestrife grows from 1.5 to 9 feet high with individual plants as wide as 5 feet at the top. Up to 30-50 annual stems can emerge from a single rootstock. The leaves are opposite and lanceolate. The large reddish-purple flowerheads occur in the axils of the tight upper leaves and are easily recognizable from late June to early September. In early autumn the leaves of the plant go through a dramatic but brief color change from green to bright red with the bright red color lasting for up to 10 days. The dead stems generally remain standing through the winter.

Mature plants can produce 1,000 seed capsules per stem with approximately 90 minute seeds per capsule, for about 2,700,000 seeds annually per plant (Thompson, et al. 1987). It has been estimated that a 1-acre stand of purple loosestrife can produce up to 24 billion seeds. Seed dispersal seems to occur mainly by water movement although wind dispersal may move seeds several yards from the parent plant. Animals and humans may also spread the seeds. The plant does not appear to be capable of spreading by rhizomes.

Although mature plants can persist for years on dry sites, seedlings become established only on moist soil sites. Establishment can occur on a variety of substrates (e.g., gravel, sand, clay, organic) and with soil pH levels ranging from acidic (4.0) to alkaline (9.1), although the optimal substrate seems to be organic and alluvial soils with a neutral to slightly acidic pH (Thompson, et al. 1987). Disturbed sites are especially prone to purple loosestrife establishment. Thompson, et al. (1987) speculated that the spread of purple loosestrife may be aided in North America by the foraging activities of muskrats on cattails.

Seed germination occurs within a temperature range of 59° to 68° F. Seedling establishment occurs in late spring and early summer (from over-wintering seeds). By 20 days the seedling is about 1.5 inches tall, the lateral and secondary roots are developed, and the first leaves appear.

Little is known about the longevity of individual purple loosestrife plants. However, stands of the plant are known to persist for decades with no apparent loss of vigor (Thompson, et al. 1987). Stands can become extensive, essentially converting diverse wetland communities to monospecific loosestrife communities.



** Excerpted from "Appendix 1: Biology of Purple Loosestrife" In U.S. Fish and Wildlife Service. 1995. Environmental Assessment of Proposed Release of Three Non-Indigenous Insects, *Galerucella calmariensis*, *Galerucella pusilla*, and *Hylobius tansversovittatus,* for the Biological Control of Purple Loosestrife (*Lythrum salicaria*). Division of Refuges, U.S. Fish and Wildlife Service, Washington, DC.